

Best Management Practices for Groundwater Protection

A Guide for Local Officials and
Public Water Suppliers



Maine Department of Human Services
Drinking Water Program

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Prepared by:
Maine Rural Water Association
Brunswick, Maine

Modified from a report by:
Emery & Garrett Groundwater, Inc
Waterville, Maine

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Groundwater Protection Best Management Practices

A Guide for Local Officials and Public Water Suppliers

I. INTRODUCTION

A. The purpose of this guide

This manual is intended for the use of local officials, public water suppliers and landowners in Maine. It is intended to encourage educated decisions, informed practice, and directed planning in regard to groundwater protection, particularly in the vicinity of public drinking water supply wells.

The purpose of groundwater protection is to avoid contamination from inappropriate land uses located close to public supply wells. The result of sound protection is that water pumped from public supply wells will meet all drinking water standards, now and in the future.

The protection of public and private drinking water supplies involves the following activities:

1. **Delineation** of an area around a well that defines the area from which groundwater flows towards the well. The total area is known as a wellhead protection area (WHPA), and is commonly divided into 2 or 3 zones that provide different levels of protection. Qualified professionals employed by either the Water System or the State Drinking Water Program usually do this work.
2. **Preparing an Inventory** of existing facilities and activities within that area. This work is usually completed by the Water System, and reviewed by the Drinking Water Program.
3. **Management** to avoid threats to groundwater quality by remediating and controlling existing sources of contamination, properly designing new facilities, and limiting certain activities within the WHPA. This work is done by property owners and applicants for new developments, guided by State or local regulations. This last activity is what this manual is intended to support.

B. Potential threats to groundwater

What is a "Potential threat to Groundwater"? Consider any land use (industrial, commercial, agricultural or domestic), and ask whether some chemical (liquid, or dissolved from a solid) could find its way down through the soil to the water table below. That is a potential threat. Once there, the chemical (or bacteria/viruses) will travel with groundwater as it makes its way to a nearby stream or lake. The problem comes when we want to use that groundwater, as pumped from wells or springs, which may be located close to, or in the line of groundwater flow from a threatening land use.

The potential threat of any land use is site-specific. It will depend on the chemical's solubility and persistence, its toxicity, the volume spilled or leached into the ground, the filtering capability of the local soil, and the proximity of wells.

The only way to deal with potential groundwater-threatening land uses is to make them less threatening. One method to reduce the severity of a potential threat is by enacting and enforcing rules to reduce the likelihood of accidental release of hazardous materials. For instance, these rules may govern handling, storage and use of hazardous materials. Foresight, ingenuity and vigilance are required at every stage – in the design and operation of containment facilities, in reductions in the amount of chemicals (such as pesticides and fertilizers) that are spread, and in selecting the appropriate site for a particular use.

This manual is about choosing appropriate sites for a particular land use, and managing those uses with the best practice. Use of this manual is intended to reduce the likelihood of accidental release of hazardous materials that may threaten groundwater resources around the wellheads of public supply wells. However, much of this best management practice could be taken to apply to land uses in general, such that all groundwater is protected, which is our ultimate goal in Maine.

C. Wellhead protection

Wellhead Protection is a practical method of ensuring the quality and quantity of water pumped from a public supply well is neither degraded nor diminished by unwise land use decisions. Wellhead protection is based upon five basic premises:

1. When water is drawn from a well, other water is drawn from the surrounding aquifer towards the well to replace it. The volume of aquifer from which water is drawn will depend upon the unique characteristics of the aquifer, like its shape, and whether it's a sand and gravel aquifer or a fractured bedrock aquifer. These and other unique characteristics can be determined by hydrogeologic studies. The volume of aquifer involved will also depend upon the pumping rate of the well and amount of recharge to the aquifer. In simple terms, given some geologic information and a few assumptions, one can calculate and draw on a map, a "Zone of Contribution" around the well.
2. Some water entering the aquifer is drawn from adjacent surface water bodies such as brooks, rivers and lakes.
3. Precipitation falling on land is the ultimate source for all water pumped from wells.
4. Rainwater (and snow melt), percolating through soils can wash contaminants into the aquifer (sometimes via adjacent surface water bodies). Such contaminants may pass through the aquifer into the well.
5. By controlling of land uses in the Zone of Contribution to the well and in the watershed of surface water bodies contributing to the well, we can protect the quality of well water.

D. Wellhead protection in Maine

The State of Maine currently designates two or three zones in the vicinity of the public water supply well. These are sometimes termed “Wellhead Protection Zones”, or “Zones of Capture”, or “Zones of Contribution”. Briefly, they are as follows:

- ◆ Zone 1 includes land areas immediately surrounding the well. These areas must receive the greatest levels of protection, namely ownership or control by the public water supplier or community.
- ◆ Zone 2 surrounds Zone 1, and should receive some measure of protection by land use controls imposed by local officials working cooperatively with the public water supplier and landowner.
- ◆ Zone 3 includes a larger land area that may include the total watershed upgradient of the well. Land use controls are usually no more stringent than current environmental protection regulations, though it is still worthwhile to identify Zone 3 for educational purposes and planning.

The State Drinking Water Program currently has a three-tiered scheme for classifying wellhead protection areas around public supply wells. All these zones have been mapped by the Maine Drinking Water Program and are available through their mapping web site. The three tiers of wellhead protection are as follows:

- ◆ Public supply wells in sand and gravel aquifers (gravel-packed wells with screens) must be protected by zones defined by “time of groundwater travel”. The process involves computer simulation of groundwater flow towards the well. The boundary of Zone 1 is set at a groundwater travel time of 200 days, which is based upon the expected life of viruses in groundwater. The Zone 2 boundary is set at 2,500 days (7 years), which is the time it might take to identify, study and remediate a chemical spill. Zone 3 may be designated as the contributing watershed to the well in question.
- ◆ Public supply wells with higher yields, and obtaining water from bedrock aquifers, are protected by three zones designated by a professional based upon relative confidence that the contributing area is properly identified. Zone 1 is defined with the highest confidence, Zone 2 somewhat less. Zone 3 may be designated as the contributing watershed to the well in question.
- ◆ Relatively small wells (e.g. those serving schools and restaurants) identify Zone 1 using a calculated fixed radius around the well that is proportionate in area to the number of people the well serves, and thus to the average yield of the well. Zone 2 is designated as a circle with a radius of 2,500 feet. There is no designated Zone 3.

E. Local action in groundwater protection

In Maine, public water supplies, whether they are water districts, water departments, private companies, mobile home parks, schools, or businesses, are responsible for providing safe drinking water. However, unless they own the land around their wells, they have no control over land use.

With few exceptions, land use control and regulation in Maine generally lies in the hands of the landowner and the municipality (local Planning Board and Code Enforcement Officer (CEO)

Large scale projects may be regulated by the Department of Environmental Protection, but for the most part, towns, landowners, and public water suppliers must work together to ensure protection of drinking water supplies.

One of the most effective ways to accomplish this is to develop and adopt a local wellhead protection or drinking water protection ordinance, or include wellhead/drinking water protection provisions in the local land use ordinance(s). This Guide, the Best Management Practices (BMPs) for Groundwater Protection was developed specifically to help local communities protect their drinking water supplies. These BMPs can be used as guidance and education for landowners and developers. They can be used to help in reviewing developments, as conditions of approval, as performance standards, or advice for landowners who may not come under official municipal review.

F. How to use this guide

1. Scan the introductory material to this manual (Sections II and III). Even if you read the headlines, you will find it educational.
2. Become familiar with the Public Water Well that is the subject of your deliberations, including its location and specifics of the delineation of the Wellhead Protection Area around it.
3. Work through the List of Potential Contamination Sources (Section IV, Table 1) until you find the one or ones that most closely fit the facility with which you are concerned.
4. Find the major activities that are associated with that potential contaminant source (Table 1, The letter codes in this table refer to the subsections of Section V of this manual).
5. Read subsection Descriptions, and Major Potential Threats.
6. Consider which BMPs should apply.
7. Apply them cautiously. Facilities may change in use over time.

II. PRINCIPLES OF GROUNDWATER CONTAMINATION

The following general principles may help in understanding how groundwater contamination occurs and how it can be avoided.

A. Piling of materials or waste can be a problem

This applies to all kinds of materials and wastes. For instance, wood wastes, including stumps, when left in the woods, do not adversely affect groundwater quality. However, when such wastes are stored in large quantities, like at a lumberyard or in a stump dump, they can cause groundwater beneath and downgradient of the pile to become contaminated. The same can be said of other organic materials, such as stored potato culls or certain types of residuals.

Unlined landfills are known to leak hazardous materials as surface water percolates through the pile. The contaminated water, or leachate, can in turn contaminate large volumes of groundwater. Similarly, uncovered sand/salt piles for road maintenance are known to lose up to half of their salt during one season, and to produce leachate that is more concentrated than sea water.

B. Everything is soluble

All chemicals are soluble to some extent, even those that we think of as not mixing with water, like gasoline. The extent to which any particular chemical is likely to be a groundwater contaminant will depend upon several factors, including: the volume used and how it is used, its solubility, its ability to adhere to soil particles or to biodegrade.

C. Heavier than water solvents can cause long lasting contamination

Chlorinated solvents, such as perchloroethene (PCE, the solvent used in dry-cleaning), trichloroethene (TCE, a common degreasing solvent) and methylene chloride (a common paint remover) are all heavier than water. If spilled on the ground, they tend to sink through soils to the water table. From here, they may sink to any depth within an aquifer. They biodegrade slowly, sometimes producing daughter chemicals that are more toxic than the original compound. Spills are very difficult or near impossible to remediate. Even salt can cause a problem in fractured bedrock aquifers. Salt water is denser than freshwater and sinks to the deepest cracks in the bedrock. In dry seasons or heavy use, these deepest cracks are tapped, and salt contaminated water may be discovered.

D. Metals are controlled by pH (acidity), and Eh (oxidation/reduction potential)

Oxidation and reduction (“redox”), and pH (to some extent), are linked to the amount of available oxygen in a particular area. Wetland soils usually are oxygen depleted and the redox potential is high. Highly reduced conditions can free toxic metal molecules from their chemical bonds and allow them to move freely in ionic form in groundwater. When groundwater receives

recharge from wetland areas, concentrations of iron and manganese pumped from wells are usually high because of the highly reduced conditions.

The same kind of situation can arise around plumes of contaminated groundwater, such as that originating from a landfill or a gasoline spill.

E. Pathogens can travel

Pathogens such as bacteria and viruses occur in domestic and municipal wastewater (in septic systems and sewers), manure, and even runoff from lawns. Pathogens are rare as groundwater contaminants except when leachfields are too close to a well, and/or the well is not properly constructed. Bacteria have a tendency to attach onto soil particles, and are not common groundwater contaminants. However, they can migrate rapidly to groundwater through shallow bedrock fractures or coarse gravel soils, and can also get into wells through insecure casings. Little is known about viruses as groundwater contaminants, except that they remain viable up to 150 days.

F. Organic chemicals are recalcitrant

While many natural organic chemicals degrade rather readily, there are many synthetic organic chemicals that do not. Gasoline additives such as MTBE (methyltertiarybutyl ethanol), ETBE (ethyltertiarybutyl ether) or TBA (tertiarybutyl alcohol) are water soluble and can travel great distances from the site of a spill.

G. Dispersion is negligible

We used to think that groundwater contamination spread fan-like away from a spill site, and that as with surface water, dilution was the solution to pollution. Recent discoveries show that most “plumes” of groundwater contamination are shaped more like a pencil, and are not wider than the source of the spill. Thus, dilution does not necessarily occur in groundwater.

H. Chemicals in common use are common groundwater contaminants

Some of the most common groundwater contaminants include salt (from deicing of roads in winter, or from sea water intrusion in coastal areas), nitrate (from over-use of fertilizers, or from septic system leachate), gasoline (from spills), and trihalomethanes (from use of chlorine products and disposal in wastewater in septic systems).

I. Geology is site specific

Every public supply well is located in a unique geologic setting. Gravel packed wells are screened in extensive and thick deposits of sand and gravel. These may or may not be covered by layers of clay that prevent recharge (and contamination) from entering the aquifer in the area around the well. Bedrock wells tap into fractures beneath the surface, which collect large volumes of groundwater both from surrounding fractures and from soils above. All wells pump groundwater that is a renewable resource replenished by rain and snowfall that trickles down

through soils. It is the purpose of these BMPs to ensure that this renewable resource is kept as clean as possible.

J. We can make contamination a thing of the past

With education and regulatory/financial incentives we have come a long way to making groundwater contamination a thing of the past. For instance we have replaced tens of thousands of underground gasoline storage tanks with technology that is designed not to leak; we have replaced the worst degreasing chemicals with citrus-based substitutes; and we now line landfills and cover sand/salt piles.

K. Planning is the key to the future

Planning the location and design of new development with groundwater protection in mind is key. One aspect of planning is the use of BMPs for land uses close to groundwater supplies, such as in Wellhead Protection Areas around public water supply wells. This is an important area of town to protect.

III. PRINCIPLES OF LAND USE REGULATION FOR GROUNDWATER PROTECTION

Because of the differences in town political structure, land use regulation, review and enforcement capacity, it is difficult to make a ‘one size fits all’ set of BMPs that are appropriate to all situations in all Maine communities. As with other local land use issues, each community will need to determine what will fit and work best in their town. The following are some simple principles that communities can use as guidance when putting together their own set of land use regulations. They can be used with the delineated wellhead protection zones as provided by the drinking water supplier or the State’s Source Water Assessment Program.

A. Keep it out

One of the most difficult problems faced by water districts and towns is determining the level of acceptable risk. Prohibition of all uses and activities will provide the most protection while careless siting of unsafe uses and activities would provide the least. The acceptable middle ground between these two options will vary from town to town. .

The simplest way to protect your water supply is to keep potential contamination sources out of the wellhead protection area. Political realities may make this a difficult option to adopt in some towns, but many towns consider the safeguard to the town investment in the water supply and ease of administration and enforcement of ‘just saying no’ a good trade-off.

B. Keep it small

If you can’t keep a potential contamination source out of the wellhead protection area, you can limit the size of development. If properly constructed and maintained, a small used car lot may present a smaller risk than a large gravel lot or a truck terminal. Keeping risks small may also mean reducing the scale of development. One fuel storage tank may only be required at the used car lot instead of 3.

C. Know what is there

Often the water supplier and the town don’t even know when and where a potential contamination source is being used or stored. Make sure that you know what is located in the wellhead protection area, and how to deal with any spills, accidents, and fires. Make sure the land owner/operator knows of his/her potential to affect the water supply. Inventories can be done on the ground and through state and local records.

D. Enforce proper maintenance and proper practice

If a business or landowner is using or storing a potential contamination source, make sure that they are using proper practices to protect the water supply. Use a multi-barrier approach, so that if there is an accident, like a problem with a holding tank or containment structure, there is a

back up to protect the water supply. Proper maintenance of structures and equipment will reduce the chance of accidents.

E. Know when there is a problem

Require those located in the wellhead protection area to promptly notify the town and water supplier when there are spills or accidents involving potential contamination sources.

F. Remember to consider potential future uses

It is tempting to allow structures or uses in the wellhead protection area because they seem innocent enough when they are proposed. But remember to consider future changes. What happens when the property changes hands? That 3-bay garage for the hobby woodworker may look like the perfect place for an auto body shop when the property goes on the market! Is this the only place in town it can be located?

G. Summary

These basic principles will help you to set your goals for wellhead protection in your town. How much risk are you willing to live with and for what reasons? Make your goals clear so that they are easily communicated to the public. Then as you review each individual provision you can go back to these goals and check your proposals with what you intend to accomplish.

IV. FACILITIES AND ACTIVITIES THAT REQUIRE ATTENTION

The State Drinking Water Program has a list of Potential Contamination Sources that public water suppliers should consider when developing a wellhead/sourcewater protection plan under the State's Wellhead/Source Water Protection Program. This Guide uses the same list. Because any one *facility* may pose a threat to groundwater in several ways, we have cross-referenced this list to the particular *activities* that pose a threat to groundwater quality.

Table 1 identifies a variety of activities that pose a potential risk of contamination. Major activities are cross-referenced to Section V of this manual. Major threats, relative risks and recommendations for prohibition are listed in the table as well.

Table 1:

Potential Contaminant Sources	Major Activities See section V for BMPs	Major Threats to Groundwater Quality	Relative Risk	Recommendations		Applicable State Regulations		Comments
				Zone 1	Zone 2	Agency	Regulatory Chapter	
Agricultural chemical spreading or spraying	A, C	fertilizers, pesticides	Medium	No	PB/PWS	DoA (BPC)	CMR 01-026 Chapter 41	Affects Phase II/V Waivers
Agricultural chemical storage	A	fertilizers, pesticides	Medium	No	PB/PWS			
Bulk grain storage	A	pesticides	Medium	No	PB/PWS			
Chemically fertilized agricultural field	C	fertilizers, pesticides	Medium	No	PB/PWS			Affects Phase II/V Waivers
Golf course	A,C	fertilizers, pesticides	Medium	No	PB/PWS			Affects Phase II/V Waivers
Herbicide sales or applicator	A, C	Herbicides	High	No	PB/PWS	DoA (BPC)	CMR 01-026 Chapter 41	
Nursery or garden shop	A, C	Fertilizers, pesticides	Medium	No	PB/PWS			
Pesticide sales or applicator	A, C	Pesticides	High	No	PB/PWS	DoA (BPC)	CMR 01-026 Chapter 41	
High voltage transmission lines	C	Herbicides	Low	No	PB/PWS			
Above ground bulk oil storage tank	A	Fuel oil	High	No	PB/PWS	Fire Marshall		
Underground oil storage tank	A	Gasoline, diesel	High	No	No	DEP	CMR 06-096 Chapter 691	
Airport fueling area	A	Jet fuel, gasoline	High	No	No	DEP	CMR 06-096 Chapter 691	
Airport maintenance	A, B	Gasoline, diesel, solvents	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	Limit size of facility in WHPA
Auto chemical supply wholesaler	A	Petroleum chemicals, solvents	Medium	No	PB/PWS			Limit size of facility in WHPA
Auto repair	B	Gasoline, solvents	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	Limit size of facility in WHPA

Potential Contaminant Sources	Major Activities See section V for BMPs	Major Threats to Groundwater Quality	Relative Risk	Recommendation		Applicable State Regulations		Comment
				Zone 1	Zone 2	Agency	Regulatory Chapter	
				No	PB/PWS	DEP	CMR 06-096 Chapter 850	Limit size of facility in WHPA
Concrete, asphalt, tar, coal company	A	PAH compounds	Medium	No	PB/PWS	DEP		Limit size of facility in WHPA
Dry cleaner	B	Perchloroethylene (PCE)	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	
Furniture stripper	B	Methylene chloride	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	
Gas station, service station	A, B	Gasoline, diesel	High	No	No	DEP	CMR 06-096 Chapter 691	Not allowed in WHPA by law
Junk or salvage yard	A, B	Gasoline, solvents	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 400	
Machine shop	B	Petroleum, solvents	High	No	PB/PWS		CMR 06-096 Chapter 850	Small storage only
Oil pipeline	A, B	Gasoline, fuel oil	Hi/med	No	PB/PWS	DEP		Special design precautions
Painters, finishers	B	Paints and solvents	Medium	No	No		CMR 06-096 Chapter 850	Small storage only
Parking lot	E, F	Petroleum, metals, PAH	Medium	No	PB/PWS	DEP		Low use parking areas only
Photo processor	B	Silver	Medium	No	PB/PWS		CMR 06-096 Chapter 850	Permit on-site rebuilding
Printer	B	Solvents	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 850	Only on sewer
Sand and gravel mining, other mining	J	Gasoline diesel, other oils	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 378	Allow no fueling on site
Small engine repair shop	B	Gasoline, solvents	Hi/med	No	PB/PWS	DEP	CMR 06-096 Chapter 850	Small storage and waste only
Snow dump (large commercial or municipal)	E, F	Petroleum, metals, PAH, nutrients	Medium	No	No	DEP		
Stormwater impoundment or run-off area	F	Petroleum, metals, PAH, nutrients	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 500	Limit size of facility in WHPA
Truck terminal	F, I	Petroleum, metals, PAH, nutrients	High	No	PB/PWS			Limit size of facility in WHPA
Animal burial (large scale)	H	Bacteria, nutrients	Medium	No	PB/PWS			Limit size of facility in WHPA
Animal grazing	C	Bacteria, nitrates	Low	Yes	PB/PWS			Limit animal density
Barneyard	C	Bacteria, nitrates	Medium	No	PB/PWS			
Manure pile	A	Bacteria, nitrates	High	No	PB/PWS			Limit size of facility in WHPA

Potential Contaminant Sources	Major Activities See section V for BMPs	Major Threats to Groundwater Quality	Relative Risk	Recommendations		Applicable State Regulations		Comments
				Zone 1	Zone 2	Agency	Regulatory Chapter	
Manure spreading	C	Bacteria, nitrates	Medium	No	PB/PWS	DoA	Guidance	Require nutrient management plan
Meat packer, slaughter house	D	Bacteria, nitrates	Medium	No	No			
Municipal wastewater treatment plant	D	Bacteria, nutrients	Medium	No	PB/PWS	DEP	Guidance	
Abandoned well	L		Medium	No	No	DHS	CMR 10-144 Chapter 232	
Boat builders, refinisher, maintenance	B	Paint chips, new paint	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	
Chemical reclamation	C	Solvents	High	No	PB/PWS	DEP	CMR 06-096 Chapter 850	
Food processor	D	Bacteria, nutrients	Low/med	No	No			
Graveyard/cemetery	H	Bacteria, nutrients	Low	No	PB/PWS			
Heat treater, smelter, annealer, descaler,	A, B	Paint, solvents	Med	No	No	DEP	CMR 06-096 Chapter 850	
Incinerator	D	Solvents	Hi/med	No	PB/PWS	DEP	CMR 06-096 Chapter, CMR 06-096 Chapter 403	
Industrial discharge	D	All	High	No	No	DEP	CMR 06-096 Chapter 850	
Industrial manufacture	A, B, C, D, E, I, K, L	All	Hi/med	No	No	DEP	CMR 06-096 Chapter 850	Limit size of facility in WHPA
Industrial waste disposal	B, C, D	All	High	No	No	DEP	CMR 06-096 Chapter 400, CMR 06-096 Chapter 850	
Landfill, dump, transfer station	D	All	High/low	No	No	DEP	CMR 06-096 Chapter 400	
Metal plating	C	Metals	High	No	No	DEP	CMR 06-096 Chapter 850	
Military facility	A, B, C, D, E, F, I, K, L	All	High	No	No	DEP	CMR 06-096 Chapter 850	
Monitoring well	L		Low	Yes	Yes	DEP, DHS	CMR 06-096 Chapter 405, CMR 10-144 Chapter 232	
Railroad yard or line	A, B	All	Medium	No	PB/PWS			
Recycling or processing center (other than beverages)	A, C, D, E, K	Solvents	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 850	Limit size of facility in WHPA
Research laboratory	A, B, D	Solvents, radioactive	Medium	No	PB/PWS			Limit size of facility in WHPA
Rust proofer	A, B, D	Fuel oil	Medium	No	PB/PWS	DEP	CMR 06-096 Chapter 850	

Potential Contaminant Sources	Major Activities See section V for BMPs	Major Threats to Groundwater Quality	Relative Risk	Recommendations		Applicable State Regulations		Comments
				Zone 1	Zone 2	Agency	Regulatory Chapter	
Salt pile or sand and salt pile (uncovered)	A	Salt	High	No	PB/PWS	DEP		Must be covered
Septic system, septic waste disposal	D		High	No	PB/PWS	DHS	CMR 01-026 Chapter 41	Limit size of facility in WHPA
Beauty parlor	B, D	Solvents	Medium	No	PB/PWS	DHS	CMR 01-026 Chapter 41	Only on sewer
Car wash	B, D	Gasoline	Low	No	PB/PWS	DHS	CMR 01-026 Chapter 41	Only on sewer
Laundromat	D		Medium	No	PB/PWS	DHS	CMR 01-026 Chapter 41	Only on sewer
Medical, dental, veterinarian office	D	Mercury, medical wastes	Medium	No	PB/PWS	DHS	CMR 01-026 Chapter 41	Only on sewer
Mortuary/funeral parlor	H	Formaldehyde	Medium	No	PB/PWS			Only on sewer
Multi-unit housing	D, G	Herbicides, chemical spraying	Medium	No	PB/PWS			Limit size of facility in WHPA
Single-family housing	D, G	Herbicides, chemical spraying	Medium	No	PB/PWS			Limit size of facility in WHPA
Sewer lines	D	Bacteria, nutrients, foul	Medium	No	PB/PWS	DEP	Guidance	Only on sewer
Sludge disposal or spreading	C, D	Bacterial, nutrients, foul	Medium	No	No	DEP	CMR 01-026 Chapter 419	
Wastewater impoundment area	D	Bacteria, nutrients, foul	High	No	No	DHS		
Wastewater treatment plant, discharge	D	Bacteria, nutrients, foul	Medium	No	PB/PWS	DHS		
Wood preserver	B	Chromium, copper, arsenic	High	No	No	DEP	CMR 06-096 Chapter 850	
Hoop houses and greenhouses	B, C	Pesticides, chemicals spraying	Medium	No	PB/PWS			
Home heating oil tanks	B	Fuel oil, kerosene	High	No	PB/PWS	OSFB	NFP Code 31	
Log yards and lumber mills		Wood waste piles	High	No	No	DEP		High iron, manganese and chemical oxygen demand

Notes:

PB = Planning Board (including ongoing monitoring by the Code Enforcement Officer)

OSFB = Oil and Solid Fuel Board (in the Maine Department of Professional and Financial Regulation)

PWS = Public Water System (owner or Utility Trustee)

NFP = National Fire Protection (not a State regulation)

DoA = Maine Department of Agriculture

DHS = Maine Department of Health and Human Services

BPC = Board of Pesticide Control (in the Maine Department of Agriculture)

DEP = Maine Department of Environmental Protection

V. BEST MANAGEMENT PRACTICES (BMPs)

The following BMPs can be associated with a wide cross section of uses and activities. For example, chemical storage occurs at automobile repair shops, beauty salons and the water district, to name a few. Since these BMPs can be incorporated in many different agricultural, commercial, industrial, retail and residential uses, we recommend that each particular use in the WHPA be scrutinized for the following particular practices.

A. CHEMICAL STORAGE

Definition: Chemical storage includes storage in tanks (above and underground), and in drums or other containers. It can also include storage of solid chemicals in bags, or in bulk (in piles or silos).

The principal chemicals of concern regarding groundwater contamination include petroleum products, solvents, agricultural chemicals, manure and road salt. Stored waste chemicals are also a concern.

- ◆ Petroleum products include gasoline and jet fuels that have low viscosity and soluble components (such as MTBE and benzene), as well as home heating oil.
- ◆ Solvents include a variety of degreasers and cleaners such as trichloroethylene (TCE), perchloroethylene (PCE) and methylene chloride, all of which are used widely in industrial and commercial facilities.
- ◆ Agricultural chemicals include nutrients/fertilizers, and various pesticides (including fungicides, herbicides and insecticides).
- ◆ Waste chemicals can include unused paints, paint scrapings, spent solvents, and diluted wash water.

Federal and State regulations make a distinction between Hazardous Materials and Hazardous Wastes. The former can include virgin materials, while the latter results from a process, including spillage. Maine state regulations apply only to hazardous wastes, although for the purposes of this manual, any chemical use can be potentially hazardous. Planning decisions should be aimed at preventing spillage in all cases.

Major potential problems for groundwater:

- ◆ Leakage of liquid chemicals from tanks and drums. Note that underground tanks are more liable to produce undetected leaks because they cannot be inspected while in operation.
- ◆ Leaching of solid chemicals in bulk, if material is exposed to precipitation.
- ◆ Massive leaching with water during fire-fighting emergencies.
- ◆ Spills during transport and delivery.

Zoning or land use recommendation:

Zone 1: Prohibit, except for uses of Public Water System

Zone 2: Use BMPs. Limit size as much as possible.

BMPs for chemical storage

1. Underground storage tanks are prohibited by State law in Wellhead Protection Areas.
2. Store all chemicals under cover, and on impervious working surfaces, without floor drains. Design storage space so that failures, emergencies, extreme storm events or routine site clearing will not cause material or wash water to run on bare ground.
3. All piping shall be designed to prevent line breakage by collision.
4. All containers and piping shall be secure and resistant to corrosion.
5. All containers shall be clearly labeled with name of chemical, and date of purchase (or generation of waste).
6. Adequate spill clean up materials must be kept on hand at the facility. Spills must be cleaned up promptly, and spilled materials disposed of properly.
7. "Pre-plans" for firefighting must be prepared bearing in mind the possibility that chemicals could cause groundwater contamination if washed out of a burning building by water. Foam materials and spray plans should be included in the plan, appropriate to the materials and quantities stored in the facility.
8. Determine if chemicals being stored are "hazardous" by characteristic, or are a listed hazardous waste by state and federal agencies. Information on hazardous materials may be obtained from the Maine DEP. If materials are either, ensure that DEP's hazardous waste regulations are being followed. In any case follow the BMPs above.
9. In addition to the standards set by the Oil and Solid Fuel Board, new home heating oil tanks should be a UL-80 listed tank with a bottom outlet, the tank ends should be welded to the body using a lap joint and not a crimp connection. Also, any outdoor home heating fuel oil tank should be sited either under the roof eave or away from falling snow or ice, should have protective filter cover, and be painted white to avoid condensation within the tank.
10. Manure, ash, and liming agents used for agricultural purposes must also be stored under cover.

Special Provision for large facilities and storage units

1. Provide secondary containment to include impervious holding of fluids of at least 20% of the volume of storage of all liquid chemicals, and 110% of the volume of the largest storage container, by permanent dikes or other means.
2. Tanks for liquid storage shall be equipped with automatic shutoffs and high level alarms. Personnel shall be trained to respond to shutoffs and alarms.
3. Prepare a Spill Prevention, Containment and Countermeasure Plan (SPCC) for submittal to the CEO, Fire Department and Water District. Information on developing an SPCC plan may be obtained from the Maine DEP. This plan shall include provisions to prevent and catch spills during loading and transfer activities. This SPCC plan shall be reviewed and updated annually.
4. Inspect all storage areas at least weekly, and maintain an inventory and tracking system.

Special Provisions for chemical storage in relation to vehicle use

1. When draining oils or fluids from vehicles, precautionary measures, such as portable drip pans, must be taken to ensure that no spills occur.
2. All fuel oil, waste oil, lubricants, antifreeze or other potential contaminants must have secondary containment equal to 110% of the liquid volume stored.

B. CHEMICAL USE

Definition: Chemical use includes but is not limited to: combustion, degreasing and other cleaning, mixing and dilution with other chemicals or water, catalytic reactions, all with or without the production of a waste material. Some waste materials are recycled on a limited scale during the process. Types of chemicals include all those listed above under chemical storage, except for agricultural chemicals, manure and road salt.

Major potential problems: Through spillage or disposal, chemical waste materials can reach soils and move through them to groundwater. Spillage or disposal can be intentional or accidental. Many chemicals have been known to contaminate groundwater to above drinking water standards.

Zoning or land use recommendation:

Zone 1: Prohibit, except for uses of Public Water System

Zone 2: Use BMPs. Limit amount of use as much as possible.

BMPs for chemical use:

1. Require the use non-hazardous alternatives to hazardous chemicals whenever possible. If hazardous chemicals must be used, provide justification for why they cannot be replaced by non-hazardous chemicals.
2. Design chemical feed lines and temporary storage containers to prevent spillage by collision and corrosion.
3. Clearly label all storage vessels and chemical feed lines with chemical name.
4. Check for spillage and leaks at least weekly. Leaking containers must be removed or placed in secure containers that are larger than the leaking container.
5. Prepare a SPCC Plan.. This plan shall include provisions for cleaning up small spills and containing large spills in an emergency. Keep emergency cleanup materials on hand. Information on developing an SPCC plan may be obtained from the Maine DEP.
6. All spills must be promptly reported to the Maine DEP, the Town (CEO and Fire Department) and the Water System.

Special provisions for chemical use in relation to vehicles

1. Vehicle washing must occur on a concrete pad with sealed sumps to capture wash water.

2. Refueling of vehicles must occur on a concrete pad with sealed sumps to capture spills.

C. CHEMICAL SPREADING OR SPRAYING

Definition: Some chemicals, including most agricultural and silvicultural chemicals, are deliberately spread or sprayed over the ground surface, or on plants. “Agricultural” applies in this case to commercial operations greater than 2 acres, hoop/greenhouses, or nursery/garden shops greater than 1,000 square feet. Transportation and utility corridors are also included in this category.

Major potential problems: Some agricultural chemicals are very soluble. If they are applied during a seasonal period of groundwater recharge (principally during the rainy spring season), much of the chemical applied will contaminate groundwater rather than being agriculturally useful.

Zoning or land use recommendation:

Zone 1: Prohibit

Zone 2: Use BMPs. Limit amount spread or sprayed as much as possible.

BMPs for spreading of agricultural chemicals:

1. Pesticide and herbicide application should be the option of last resort. Any activity requiring the use of herbicides or pesticides should develop an Integrated Pest Management Plan that details the conditions under which agricultural chemicals are to be used. All pesticides shall be applied in accordance with label directions and the regulations of the Maine Board of Pesticides Control.
2. Herbicides and pesticides must be applied only by trained personnel, i.e. by certified applicators, who must be informed regarding the delineated area of wellhead protection.
3. All agricultural fertilizers shall be applied in accordance with label directions, and must be applied in accordance with an approved Nutrient Management Plan.
4. Fertilizer applications are to be tailored to the specific needs of the crop, as determined by soil suitability analyses. Use of slow-release fertilizers is preferred.
5. Irrigation schedules shall be coordinated with pesticide and nutrient application to minimize the possibility of leaching. Do not apply to frozen ground, or immediately before storm events.
6. Notice of intent to apply agricultural chemicals shall be given to the CEO and public water supplier prior to application.

BMPs for spreading of organic materials in agriculture:

1. A Nutrient Management Plan must be provided for all agricultural activities within the WHPA.

2. Only Class “A” composted residuals may be used within WHPA. These residuals must have an approved Program License from the Maine Department of Environmental Protection, and must be used in strict accordance with all license provisions. Any non-composted residual or a residual not meeting the Class “A” pathogen reduction standard should not be spread within the WHPA. See Section D.3 below for more information on residuals.
3. Manure may be used within the WHPA, but must be applied in accordance with the nutrient management plan.
4. Tailor application of approved residuals and manures to the specific needs of the crop, as determined by soil suitability analyses.
5. Residuals and manures shall not be applied over very shallow soils (less than 1 foot) or exposed bedrock.
6. Residuals and manure shall not be applied on frozen ground, or immediately before storm events.

D. WASTEWATER AND SOLID WASTE

Definition: Wastewater results from the flushing of waste products in a water-soluble or water-based form. It can include a wide variety of different types of wastes. Solid Waste includes solid material that is either incinerated or disposed of in landfills.

Major potential problems:

1. Domestic and municipal wastewater.

Domestic and municipal wastewater is high in organic matter in the process of decomposition. It is treated most commonly by aeration in a lagoon, and/or by land disposal via a septic system leachfield (drainfield). Soils are usually excellent for removing very high concentrations of bacteria within a few hundred feet from a septic system. However, leachfields are common sources of nitrate-rich leachate in groundwater.

2. Chemical wastewater disposal

Some chemical wastes are discharged improperly via septic system leachfields. Industrial wastewater disposal is regulated by the state, and except for the state plumbing code, commercial, retail and domestic wastewater disposal may not be regulated. Improper disposal of some chemicals may result in groundwater contamination. The most common such disposal is of chlorine products, which produce trihalomethanes in groundwater.

3. Residuals

Municipal wastewater treatment plants produce a residual product, commonly known as sludge. Residuals are mostly organic, but may also contain concentrations of metals or other chemicals. Under state law, residuals are solid wastes generated from municipal, commercial or industrial facilities that may be suitable for agronomic use. Due to the potential to impact ground and surface waters if improperly handled, the use of these materials are strictly regulated by the DEP.

Only composted residuals meeting the Class “A” level of pathogen reduction should be used in the WHPA. For more information on the composting and pathogen reduction standards, contact the Maine DEP.

4. Solid waste landfills

Municipal solid waste disposed of in landfills produces a leachate that is very similar to domestic and municipal wastewater in concentrations and components. The leachate can contain chemical components that result in groundwater contamination downgradient of landfills. Liner systems for land fills can reduce the risk of contamination, but they are not completely secure.

5. Incinerator ash

Municipal incinerator ash commonly has elevated concentrations of various trace metals, which could potentially be mobilized through soils to groundwater below.

6. Wood waste

Wood waste, though innocuous in the woods, can be the cause of groundwater contamination beneath log storage yards and piles of wood waste (bark, slabs, sawdust). Iron and manganese, chemical oxygen demand and tannin/lignin are all elevated and can create a vile odor in the water.

7. Floor drains

Floor drains can wash hazardous chemicals directly to groundwater. State and Federal law prohibits them at sites where there is a significant potential for industrial, hazardous or toxic liquids – including gasoline, oils or degreasers – to drip, be spilled or washed into the floor drains.

Zoning or land use recommendation:

Zone 1: Prohibit

Zone 2: Use BMPs.

BMPs for wastewater and solid waste:

1. Municipal wastewater facilities, chemical waste disposal sites of any kind, spreading of biosolids (this should be made consistent with what is permissible for manure in similar zones – i.e. if manure and fertilizer application is allowed in Zone 1, so should residuals use due to the risk assessment indicating state rules are based upon the concept of “equivalent protection”) and incinerator ash, solid waste landfills, log storage yards and lumber yards, and facility floor drains shall be prohibited in WHPAs
2. Septic systems and sewer pipes shall be prohibited in Zone 1 WHPAs (Zone 1 is 300 ft in many cases).
3. Sewer pipes shall preferably be relocated outside WHPAs. Alternatively, pipes may be lined internally where buried within Zone 2 WHPAs.

E. STORM WATER AND PARKING LOTS

Definition: Storm water is derived from precipitation (rain or melted snow) that drains rapidly from relatively impervious surfaces such as roofs and parking lots.

Major potential problems: Impervious surfaces or grading of the land to accelerate drainage prevents natural recharge of precipitation to groundwater. Even gravel driveways and lawns drain water quickly. Storm water from “active areas” such as frequently used parking lots may contain significant concentrations of contaminants such as petroleum products, metals and salt. (By contrast, “inactive” impervious surfaces such as roofs can produce useful, clean recharge water.)

Zoning or land use recommendation:

Zone 1: Prohibit parking areas, except for Public Water System uses.

Zone 2: Use BMPs. Limit amount of impervious area including but not limited to parking, sidewalks, rooflines and as much as possible.

BMPs for storm water:

1. Zone 1 WHPAs, the impervious area of any lot should be limited to 10% or less of the lot to encourage natural recharge.
2. Zone 2 WHPAs, the impervious area of any lot should be limited to 15% or less of the lot to encourage natural recharge.
3. Use of vegetated buffers and pervious pavement options should take priority over structural storm water control like detention ponds.
4. Stormwater should be diverted away from WHPAs if possible.
5. Infiltration of stormwater from impervious areas greater than 20,000 square feet should be prohibited. Any detention or retention structures should be constructed in such a manner that excludes groundwater interaction.

F. ROAD MAINTENANCE

Definition: The one aspect of road maintenance that causes significant groundwater contamination is winter de-icing with salt.

Major potential problems: Uncovered sand and salt piles can leach almost half their salt into groundwater. The use of pure salt on highways has increased the incidence of nearby domestic wells becoming contaminated.

Zoning or land use recommendation:

Zone 1: Minimize use of salt.

Zone 2: Use BMPs. Limit size of pile as much as possible.

BMPs for road maintenance:

1. Cover all sand and salt piles.
2. Minimize use of salt in all cases.

G. RESIDENTIAL ACTIVITIES AND HOME OCCUPATIONS

Definition: Residential activities include: production of septic wastes, use of gasoline or fuel oil, automotive or similar shop work, lawn or garden care with fertilizers and pesticides, and use and disposal of chemicals from home occupations such as photographic studios, beauty salons, car washing activities, etc.

Major potential problems: Most homes contain stores of small quantities of several hazardous chemicals (gasoline, fuel oil, bleach, paint thinners, pesticides, drain cleaners, etc.). Many homeowners are unaware that disposal of small quantities of these chemicals through septic systems or on the ground may cause significant groundwater contamination.

Zoning or land use recommendation:

Zone 1: Prohibit residential development, if possible.

Zone 2: Use BMPs. Limit residential development and/or type and scope of home businesses.

BMPs for residential activities:

1. Residential uses should be prohibited in Zone 1 WHPAs if possible. If allowed they should be located on lots of at least 5 acres, with a requirement that septic wastes are to be disposed of at least 300 feet from the well and with at least 10 feet of soil cover, and a replacement leachfield be designated with similar stipulations.
2. Residential uses may be allowed in Zone 2 WHPAs, with net density of at least 2 acres/unit, with a requirement that a replacement leachfield be designated on each lot.
3. Developers of residential subdivisions within WHPAs shall complete a nitrate loading study. Nitrate and nitrite concentrations should not exceed 50 mg/L at the property line.
4. Residents of properties located within Zone 2 WHPAs should be informed of the potential for groundwater contamination from domestic use of various chemicals.
5. Home occupations proposed for WHPAs shall come under Planning Board review for consideration of how they may impact groundwater quality. No disposal of chemicals from home occupations shall be allowed within WHPAs.
6. Vehicles within Zone 1 WHPAs must be parked on impermeable surfaces.
7. Home heating oil tanks shall be prohibited in Zone 1 WHPAs, and replaced with alternative fuel or heating sources.
8. New homes should be constructed without sumps that discharge to bare soil.
9. New home and replacement home heating fuel oil tanks must meet the standards set by the Oil and Solid Fuel Board, In addition, new home or replacement heating oil

tanks should be a UL-80 listed tank with a bottom outlet, the tank ends should be welded to the body using a lap joint and not a crimp connection. Any outdoor home heating fuel oil tank should be sited either under the roof eave or away from falling snow or ice, should have protective filter cover, and be painted white to avoid condensation within the tank.

Any spills from residential activities should be reported to the Public Water Supply and CEO.

H. GRAVE SITES

Definition: Gravesites include not only human cemeteries, but also mass graves for animals (with >1000 lbs of carcass in one burial site).

Major potential problems: Single burials are not a problem, however, mass graves can overload the soils capacity to decay organic material and can cause significant deterioration of groundwater quality. Fortunately, composting of carcasses produces no leachate or groundwater contamination. Also, large human cemeteries are frequently well manicured with continual chemical spraying and spreading. See Sections B and C above.

Zoning or land use recommendation:

Zone 1: Prohibit

Zone 2: Use BMPs.

BMPs for cemeteries:

1. Cemeteries should not be permitted in Zone 1, WHPAs.
2. Carcasses should be composted rather than buried.

I. FIRE PROTECTION

Definition: Firefighting includes prevention as well as activities associated with emergency dowsing of fires.

Major potential problems: Water used to control fires at chemical storage sites can cause widespread groundwater contamination because the water becomes contaminated before leaving the site. In addition, chemicals stored or in use at the location of the fire could potentially leak and cause widespread groundwater contamination.

BMPs for firefighting within WHPA's:

1. Prepare "Pre-Plan" for fire prevention and fire suppression for all facilities within WHPAs. These plans should be tailored to the materials stored on site, and designed to limit groundwater contamination in the event of fire. This emergency contingency plan should be part of any SPCC plan developed under Section B and C above.
2. Contingency Plans and meetings with the local fire department should be required.

J. MINING

Definition: Mining involves the removal of mineral materials from the earth. It can include excavation of sand and gravel, removal of rock, or extraction of metallic ores.

Major potential problems: Mining for metallic ores presents the greatest problem in regards to water quality, with generation of leachate that is generally acid and with high concentrations of metals. Mining for rock or sand and gravel may, under some circumstances, cause unintended changes in the flow of groundwater. Any mining produces pits, which can be used for illegal dumping. Vehicles used for mining may be the cause of spills. Rock crushers use water that may wash pollutants into the groundwater.

Zoning or land use recommendation:

Zone 1: Prohibit

Zone 2: Use BMPs. Limit size as much as possible.

BMPs for mining:

1. No part of any extraction operation may be permitted within 150 feet of any property or street line, except that drainage ways to reduce run-off into or from the extraction area may be allowed up to 100 feet from such line. No part of the extraction operation, including drainage and runoff control features, may be permitted within 100 feet of the normal high-water line of a water body or upland edge of a wetland. Natural vegetation must be left and maintained on the undisturbed land. Excavation may not occur below the level of the traveled surface of any street, road, or right-of-way within 150 feet of that street, road, or right-of-way, except that excavation below the traveled surface level may occur within 150 feet of a private road or right-of-way with the written permission of the owner of that road or right-of-way. A natural buffer strip at least 150 feet wide must be maintained between any excavation and a property boundary, including a street right-of-way. This distance may be reduced to not less than 10 feet with the written permission of the affected abutting property owner or owners, except that the distance may not be reduced to less than 25 feet from the boundary of a cemetery or burial ground. The distance between excavations owned by abutting owners may be reduced to not less than 75 feet with the abutter's written permission.
2. Separation must be maintained between any excavation and any public drinking water source as follows: (1) For systems serving a population of 500 persons or less, the minimum separation must be 300 feet; (2) For systems serving a population of 501 persons up to 1,000 persons, the separation must be 500 feet; (3) For systems serving a population of more than 1,000 persons, the separation must be 1,000 feet; and (4) For any system that holds a valid filtration waiver in accordance with the federal Safe Drinking Water Act, the separation must be 1,000 feet
3. If any standing water accumulates, the site must be fenced in a manner adequate to keep out children. Measures must be taken to prevent or stop the breeding of insects.

4. No slopes steeper than 3 feet horizontal to 1 foot vertical are permitted at any extraction site unless a fence at least 6 feet high is erected to limit access to such locations.
5. Before commencing removal of any earth materials, the owner or operator of the extraction site must present evidence to the Planning Board of adequate insurance against liability arising from the proposed extraction operations, and such insurance must be maintained throughout the period of operation.
6. Any topsoil and subsoil suitable for purposes of revegetation must, to the extent required for restoration, be stripped from the location of extraction operations and stockpiled for use in restoring the location after extraction operations have ceased. Such stockpiles must be protected from erosion, according to the erosion prevention performance standards of this section.
7. Sediment must be trapped by diversions, silting basins, terraces or other measures designed by a professional engineer.
8. The sides and bottom of cuts, fills, channels, and artificial water courses must be constructed and stabilized to prevent erosion or failure.
9. The hours of operation at any extraction site must be limited as the Planning Board deems advisable to ensure operational compatibility with nearby residences.
10. Excavation may not extend below 5 feet above the seasonal high water table without the submission of detailed findings of the depth of the water table. The Board may, upon verified determination of the depth of the seasonal high water table, permit excavation within 2 feet above the water table.
11. Loaded vehicles must be suitably covered to prevent dust and contents from spilling or blowing from the load, and all trucking routes and methods are subject to approval by the Road Commissioner and the Planning Board. No mud, soil, sand, or other materials may be allowed to accumulate on a public road from loading or hauling vehicles.
12. All access and or egress roads leading to or from the extraction site to public roads must be treated with suitable materials to reduce dust and mud for a distance of at least 100 feet from such public roads.
13. No equipment debris, junk, or other material is permitted on an extraction site. Any temporary shelters or buildings erected for such operations and equipment used in connection therewith must be removed within 30 days following completion of active extraction operations.
14. Within 6 months of the completion of extraction operations at any extraction site or any one or more locations within any extraction site, ground levels and grades must be established in accordance with the approved plans filed with the Planning Board. These plans must provide for the following:
 15. All debris, stumps, boulders, and similar materials must be removed or disposed of in an approved location or buried and covered with a minimum of two feet of soil.
 16. The extent and type of fill must be appropriate to the use intended. The applicant must specify the type and amount of fill to be used.
 17. Storm drainage and water courses must leave the location at the original natural drainage points and in a manner such that the amount of drainage at any point is not significantly increased.

18. At least 4 inches of topsoil or loam must be retained or obtained to cover all disturbed areas, which must be reseeded and property restored to a stable condition adequate to meet the provisions of the "Erosion and Sediment Control, Best Management Practices," published by the Maine Department of Environmental Protection.
19. No slope greater than 3 feet horizontal to 1 foot vertical is permitted.
20. Disused gravel pits within the WHPA shall be reclaimed according to plans submitted to the Municipality.
21. Gravel mining activities in Wellhead Protection Areas must have emergency spill response plans.
22. Fuel storage and refueling areas must be equipped with secondary containment, or refueling and maintenance must take place outside the designated WHPA?

K. FILL

Definition: Fill is contaminated if it has a non-natural odor, or is stained, or comes from a known source of contamination, such as the site of an underground tank removal project.

Major potential problems: Contaminated fill can become the source for groundwater contamination for long periods, as the contamination is leached out into the subsurface.

BMPs for fill:

1. Use only inert material (loam, sand, gravel, clay, rocks, bricks or concrete).
2. Use only clean fill (no non-natural odors, no staining, and not originating at a known spill site).
3. Implement erosion and sedimentation control measures.

L. WELLS

Definition: Wells are structures (usually vertical shafts) used to access groundwater for extraction or monitoring purposes.

Major potential problems: Wells provide a possible conduit for contaminants originating in surface water or upper aquifers to migrate to groundwater below. Wells placed within the same Zone of Groundwater Contribution will interfere with each other, causing a reduction in the Safe Yield of both.

BMPs for wells:

1. Wellheads shall be designed such that surface water does not enter groundwater through the borehole around the well casings.
2. Wells that are no longer in service for extraction or monitoring shall be abandoned in a manner appropriate to prevent the entry of contaminants and mixing of separate subsurface water-bearing zones. This may involve the use of bentonite and/or cement grout where a water-tight seal is deemed necessary.

3. High yielding wells (for uses other than domestic purposes) will only be allowed in the WHPA if a safe yield analysis, conducted by a Maine Certified Geologist, can demonstrate that there is sufficient water for both the new well and the public water source.